MWV

Notice of Allowability	**Application No.** 10/680,778	**Applicant(s)** KEARL, DANIEL A.
	Examiner Tracy Dove	**Art Unit** 1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 9/24/04.
2. ☒ The allowed claim(s) is/are 1-34,36-38,77 and 78.
3. ☒ The drawings filed on 07 October 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 10/7/03
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date attached.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Julia Dierker on 12/7/04.

The application has been amended as follows:

In the specification:

At page 1, line 13; after "April 19, 2001", insert ", now U.S. Patent 6,677,070, issued January 13, 2004".

In the claims:

1. (Currently Amended) A fuel cell, comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well; and

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well.

2. (Previously presented) The fuel cell as defined in claim 1 wherein the electrolyte layer has a thickness ranging from greater than 0 microns to about 20 microns.

3. (Previously presented) The fuel cell as defined in claim 2 wherein the electrolyte layer has a thickness greater than 0 microns to about 10 microns.

4. (Original) The fuel cell as defined in claim 3 wherein the electrolyte layer has a thickness ranging between about 2 microns and about 5 microns.

5. (Currently amended) The fuel cell as defined in claim 1 wherein each of the anode and cathode layers has a thickness of ~~at least~~ about 30 microns or more.

6. (Original) The fuel cell as defined in claim 5 wherein each of the anode and cathode layers has a thickness ranging between about 30 microns and about 500 microns.

7. (Previously presented) The fuel cell as defined in claim 1 wherein the anode layer has an interconnected porosity ranging between about 19% and about 55%; and the cathode layer has an interconnected porosity ranging between about 19% and about 55%.

8. (Original) The fuel cell as defined in claim 7 wherein each of the anode layer interconnected porosity and the cathode layer interconnected porosity ranges between about 20% and about 25%.

9. (Previously presented) The fuel cell as defined in claim 1 wherein the electrolyte layer comprises a material selected from the group consisting of yttria stabilized zirconia, samaria doped ceria, partially stabilized zirconia, stabilized bismuthsesquioxide (Bi_2O_3), tantalum pentoxide (Ta_2O_5), and lanthanum strontium gallium magnesium oxide.

10. (Original) The fuel cell as defined in claim 9 wherein the electrolyte layer consists essentially of Ta_2O_5.

11. (Original) The fuel cell as defined in claim 9 wherein the electrolyte layer consists essentially of lanthanum strontium gallium magnesium oxide.

12. (Previously presented) The fuel cell as defined in claim 1 wherein the anode layer comprises a material selected from the group consisting of nickel (Ni), Ni-yttria stabilized zirconia cermet, copper doped ceria, gadolinium doped ceria, strontium doped ceria, yttria doped

ceria, Cu-YSZ cermet, Co-stabilized zirconia cermet, Ru-stabilized zirconia cermet, LSGM + nickel oxide, and mixtures thereof.

13. (Previously presented) The fuel cell as defined in claim 1 wherein the cathode layer comprises a material having a perovskite structure.

14. (Original) The fuel cell as defined in claim 13 wherein the cathode layer comprises a material selected from the group consisting of lanthanum strontium manganate, lanthanum strontium ferrite, lanthanum strontium cobaltite, $LaFeO_3/LaCoO_3$, $YMnO_3$, $CaMnO_3$, $YFeO_3$, and mixtures thereof.

15. (Previously presented) The fuel cell as defined in claim 1 wherein the cathode layer comprises silver.

16. (Previously presented) The fuel cell as defined in claim 1, the fuel cell further comprising:

a first interfacial layer, positioned between the anode and the electrolyte; and
a second interfacial layer positioned between the cathode and the electrolyte.

17. (Original) The fuel cell as defined in claim 16 wherein the first interfacial layer comprises yttria doped ceria (YDC).

18. (Original) The fuel cell as defined in claim 16 wherein the second interfacial layer comprises yttria stabilized bismuthsesquioxide (YSB).

19. (Currently amended) The fuel cell as defined in claim 1, further comprising a connecting material for connecting the fuel cell to at least one of an electrical load or an electrical storage device, the connecting material deposited on at least one of the anode layer or the cathode layer.

20. (Currently amended) A fuel cell, comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well;

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well; and

a connecting material for connecting the fuel cell to at least one of an electrical load ~~and~~ or an electrical storage device, the connecting material deposited on at least one of the anode layer ~~and~~ or the cathode layer;

wherein the electrical load comprises at least one of computers, portable electronic appliances, or communication devices.

21. (Currently Amended) A fuel cell, comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well;

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well; and

a connecting material for connecting the fuel cell to at least one of an electrical load ~~and~~ or an electrical storage device, the connecting material deposited on at least one of the anode layer ~~and~~ or the cathode layer;

wherein the electrical storage device comprises at least one of capacitors, batteries, or power conditioning devices.

22. (Currently amended) A fuel cell, comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well;

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well; and

a connecting material for connecting the fuel cell to at least one of an electrical load ~~and~~ or an electrical storage device, the connecting material deposited on at least one of the anode layer ~~and~~ or the cathode layer;

wherein the connecting material has as a main component thereof a material selected from the group consisting of silver, palladium, platinum, gold, titanium, tantalum, chromium, iron, nickel, carbon, stainless steels, high temperature nickel alloys, tungsten, and mixtures thereof.

23. (Currently amended) A fuel cell system including a plurality of fuel cells, each of the plurality of fuel cells comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer or a thick film cathode layer disposed on the electrolyte first surface and within the well; and,

the other of the thick film cathode layer or the thick film anode layer disposed on the electrolyte second surface and within the counter well;

~~The fuel cell as defined in claim 1, further comprising a~~ wherein the fuel cell system further comprises an interconnecting material for interconnecting at least two of the plurality of fuel cells, the interconnecting material deposited on at least one of the thick film anode layer or the thick film cathode layer.

24. (Currently amended) The fuel cell system as defined in claim 23 wherein the interconnecting material is a material selected from the group consisting of lanthanum chromites, nickel, copper, titanium, tantalum, chromium, iron, carbon, stainless steels, high temperature nickel alloys, tungsten, and mixtures thereof.

25. (Currently Amended) The fuel cell system as defined in claim 23 ~~79~~, further comprising:

~~a~~ the plurality of ~~the~~ fuel cells arrayed within the substrate;

an electrical connection between ~~the~~ a plurality of the thick film anode layers; and

an electrical connection between ~~the~~ a plurality of the thick film cathode layers.

26. (Currently amended) The fuel cell system as defined in claim 25 wherein the plurality of fuel cells are connected within a planar array, the planar array having a first plane adapted to contact a source of oxygen, the first plane having ~~a~~ the plurality of thick film cathode layers therein, the planar array further having a second plane opposed to the first plane, the second plane adapted to contact a fuel, the second plane having ~~a~~ the plurality of thick film anode layers therein.

27. (Currently amended) The fuel cell system as defined in claim 26 wherein the source of oxygen is air.

28. (Currently amended) The fuel cell system as defined in claim 26 wherein the fuel is selected from the group consisting of methane, butane, propane, pentane, methanol, ethanol, higher straight chain or mixed hydrocarbons, and mixtures thereof.

29. (Previously presented) The fuel cell as defined in claim 1 wherein the fuel cell has a power density of between about 100 mW/cm^2 and about 2000 mW/cm^2.

30. (Original) The fuel cell as defined in claim 29 wherein the fuel cell has a power density of between about 1000 mW/cm^2 and about 2000 mW/cm^2.

31. (Original) The fuel cell as defined in claim 30 wherein the fuel cell has an operating temperature of between about 400EC and about 800EC.

32. (Original) The fuel cell as defined in claim 31 wherein the fuel cell has an operating temperature of between about 400EC and about 600EC.

33. (Original) The fuel cell as defined in claim 32 wherein the fuel cell has an operating temperature of between about 400EC and about 500EC.

34. (Currently amended) A fuel cell, comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the electrolyte layer has a thickness greater than 0 microns to about 10 microns, and wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well; and

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well;

wherein each of the anode layer and the cathode layer has an interconnected porosity ranging between about 19% and about 55%, and wherein at least one of the anode or cathode layers has a thickness of ~~at least~~ about 30 microns or more.

35. (Cancelled).

36. (Previously presented) The fuel cell as defined in claim 34 wherein the electrolyte layer comprises a material selected from the group consisting of yttria stabilized zirconia, samaria doped ceria, partially stabilized zirconia, stabilized bismuthsesquioxide (Bi_2O_3), tantalum pentoxide (Ta_2O_5), and lanthanum strontium gallium magnesium oxide; wherein the anode layer comprises a material selected from the group consisting of nickel (Ni), Ni-yttria stabilized zirconia cermet, copper doped ceria, gadolinium doped ceria, strontium doped ceria, yttria doped ceria, Cu-YSZ cermet, Co-stabilized zirconia cermet, Ru-stabilized zirconia cermet, LSGM + nickel oxide, and mixtures thereof; and wherein the cathode layer comprises a material selected from the group consisting of lanthanum strontium manganate, lanthanum strontium ferrite, lanthanum strontium cobaltite, $LaFeO_3/LaCoO_3$, $YMnO_3$, $CaMnO_3$, $YFeO_3$, silver, and mixtures thereof.

37. (Previously presented) The fuel cell as defined in claim 34, the fuel cell further comprising:

a first interfacial layer, positioned between the anode and the electrolyte; and

a second interfacial layer positioned between the cathode and the electrolyte.

38. (Currently amended) The fuel cell as defined in claim 37, further comprising a connecting material for connecting the fuel cell to at least one of an electrical load or an electrical storage device, the connecting material deposited on at least one of the anode layer or the cathode layer, wherein the electrical load comprises at least one of computers, portable

electronic appliances, or communication devices, and wherein the electrical storage device comprises at least one of capacitors, batteries, or power conditioning devices.

39-76. (Canceled)

77. (Currently amended) A fuel cell system including a plurality of fuel cells, each of the plurality of fuel cells comprising:

a well in a dielectric or semiconductor substrate, the substrate having a first side and a second side, the second side opposed to the first side, the well being defined in the first side;

a counter well defined in the second side, wherein an opening is defined in the substrate between the well and the counter well;

a thin film electrolyte layer having a first surface and a second surface, the first surface being opposed to the second surface, wherein the second surface contacts the well and covers the opening;

one of a thick film anode layer ~~and~~ or a thick film cathode layer disposed on the electrolyte first surface and within the well; and

the other of the thick film cathode layer ~~and~~ or the thick film anode layer disposed on the electrolyte second surface and within the counter well;

wherein the fuel cell system comprises:

a planar array of the plurality of ~~the~~ fuel cells within the substrate;

an electrical connection between ~~the~~ a plurality of the thick film anode layers; and

an electrical connection between ~~the~~ a plurality of the thick film cathode layers.

78. (Currently amended) The fuel cell system as defined in claim 77 wherein the planar array has a first plane adapted to contact a source of oxygen, the first plane having ~~a~~ the plurality of thick film cathode layers therein, the planar array further having a second plane opposed to the first plane, the second plane adapted to contact a fuel, the second plane having ~~a~~ the plurality of thick film anode layers therein.

79-83. (Canceled)

Allowable Subject Matter

Note the above Examiner amendments were required to correct formal matters (35 U.S.C. 112, 2nd issues) only and were not made to overcome the prior art of record.

Claims 1-34, 36-38, 77 and 78 are allowed.

The following is an examiner's statement of reasons for allowance: the claims are directed toward a fuel cell comprising a dielectric or semiconductor substrate having a well defined in a first side of the substrate and a counter well defined in a second side of the substrate. An electrolyte has a second surface that contacts the well and covers an openings between the well and the counter well. A first electrode is disposed on a first surface of the electrolyte and contained within the well and a second electrode is disposed on the second surface of the electrolyte and contained within the counter well. The electrolyte between the first electrode and the second electrode is contained within the substrate. Both electrodes and the electrolyte are contained within a single substrate.

The prior art does not teach the claimed invention. Ohlsen et al. (US6,641,948) teaches fuel cells having silicon substrates and/or sol-gel derived support structures. However, the anode is contained in a first silicon substrate and the cathode is contained in a second silicon substrate. Ohlsen does not teach the anode and cathode are contained within the same silicon substrate. Furthermore, an electrolyte layer (704) is not contained within the silicon substrate, as required by the claimed invention.

Marsh (US6,312,846) teaches a fuel cell that is formed on a semiconductor wafer by etching a channel in the wafer and forming a proton exchange membrane (PEM) barrier in the etched channel. Marsh does not teach the anode and cathode are contained within the semiconductor water. The claimed invention requires a well formed in a first surface of the substrate and a counter well formed in a second surface of the substrate. Marsh teaches a single channel is etched in a single surface of the semiconductor wafer. Marsh teaches the fuel cell is formed on the wafer, not within the wafer. Marsh does not teach a first electrode disposed in a well and a second electrode disposed in a counter well wherein an electrolyte is disposed in an opening between the well and the counter well.

Kearl (US6,677,070) teaches the claimed invention (see at least Figs. 13 and 15), however, Kearl is not available as prior art against the claimed invention. The present application is a continuation of Kearl (US6,677,070). There is no double patenting between the Kearl patent and the claimed invention because the claims of the Kearl patent do not contain the limitation of a dielectric or semiconductor substrate having a well and a counter well. Furthermore, the claimed invention does not require an electrolyte consisting essentially of Ta_2O_5, as required by the Kearl patent.

Kearl (US2004/0091609) teaches the claimed invention (see at least Figs. 13 and 15), however, Kearl is not available as prior art against the claimed invention. Kearl (US2004/0091609) is a divisional application of Kearl (US6,677,070). Note Kearl (US2004/0091609) was filed in response to a restriction requirement, mailed 4/20/04, required by Examiner Winter in the present application.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Malhi (US5,789,093) teaches a fuel cell comprising a ceramic or graphite material manifold. Lehmann et al. (US5,262,021) teaches a method of manufacturing a perforated semiconductor workpiece. George et al. (US6,361,893) teaches a planar fuel cell utilizing nail current collectors for increased active surface area.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is 571-272-1285. The examiner can normally be reached on Monday-Thursday (9:00-7:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tracy Dove

Tracy Dove
Patent Examiner
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